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Deliverable D8.2 (DS4.1.1): perfSONAR MDM – additional use- case proposals



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Table of Contents

Abstract	1	
Executive Summary		2
1	Introduction	3
2	perfSONAR Use Cases	4
2.1	LHCONE	4
2.1.1	Introduction	4
2.1.2	A dedicated perfSONAR solution for LHCONE VRF	5
2.1.3	The proposed supporting activities	12
2.2	EGI	12
2.2.1	Introduction and background	12
2.2.2	Collaboration between EGI.eu and GÉANT/DANTE	13
2.2.3	The proposed supporting activities	14
2.3	Future Internet: XIFI	14
2.3.1	Introduction	14
2.3.2	XIFI activities	15
2.3.3	perfSONAR MDM for Future Internet	15
2.3.4	The proposed supporting activities	16
Conclusions	18	
References	19	
Glossary	20	

Table of Figures

Figure 2.1: Event Management Infrastructure implemented for LHCONE in Nagios	6
Figure 2.2: Mock-up of link utilisation on the perfSONAR MDM web user interface	7
Figure 2.3: Mock-up of One-Way Delay, Jitter, Packet Loss and Traceroute on the perfSONAR MDM web user interface	8
Figure 2.4: Accessing Bandwidth Controller Historic Measurements on the perfSONAR MDM web user interface	9
Figure 2.5: Performing an on-demand Bandwidth Controller measurement on the perfSONAR MDM web user interface	10
Figure 2.6: Choosing a metric on the weathermap	11
Figure 2.7: The weather map coloured according to the One-Way Delay	11
Figure 2.8: An extract from EGI.eu and DANTE/GÉANT MoU [MoU], referring to perfSONAR MDM13	

Table of Tables

Table 2.1: List of the first XIFI sites and their current monitoring tools	16
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Abstract

This document puts forward three new use cases for consideration for implementation later in the project. The findings will be linked to the Milestone MS72 (MS4.1.1 perfSONAR use-cases selection), due one month after this deliverable.

Executive Summary

This deliverable describes three use cases that are short-listed as the main areas of focus for the perfSONAR MDM group for the remainder of the GN3plus project. Use cases in this project include user groups, since the combination of projects with their user communities is of great interest to SA4 T1.

The LHCONE (Large Hadron Collider Optical Network Environment) is a strong target group for integrated monitoring, troubleshooting and alarms systems. We propose a customized central visualization that can accommodate the variety of existing measurement devices. Further work would be to enhance communication with the group and to deliver training and tutorials to consolidate the position of perfSONAR MDM.

EGL.eu has already shown interest in perfSONAR MDM, as demonstrated by a common MoU [MoU]. In the case of proceeding with this stated intent, the required work on the GÉANT project would involve supporting EGL.eu in deployment, user training and evolving the measurement suite software to meet the needs of their project in detail.

In contrast, Future Internet/XIFI is a new project, sharing the same start time as GN3plus. As such, supporting them would require beginning at the design stage with requirements gathering, evaluating the technical solutions possible and would be followed by the implementation and support phase.

Following this deliverable, the SA4 T1 team will decide on the use cases to follow up on and finally select two to proceed with over the course of GN3plus.

1 Introduction

perfSONAR MDM (Multi-Domain-Monitoring) is the multi-domain monitoring service for the GÉANT Service Area (GSA): it enables NREN NOCs (Network Operation Centres) and PERTs (Performance Enhancement and Response Teams) to collaborate in providing seamless network performance. perfSONAR allows the two groups to work together to identify, prevent and solve performance issues for network users, allowing them to assess network integrity by measures such as latency and achievable bandwidth. One of the biggest advantages of perfSONAR though is the ability to test and verify the connectivity of remote network sections in a multi-domain environment without the requirement of high privileged access.

In GÉANT3plus, we aim to further expand this service. Besides continual work on the existing platform in order to fix issues encountered and to adapt to new requirements, there will also be work on further broadening the usefulness of perfSONAR by integrating new use cases.

This document will propose new use cases for selection and implementation later in the project. It is linked to the Milestone MS72 (MS4.1.1 perfSONAR use-cases selection), due one month after this deliverable, where well-grounded choices will be defined..

2 perfSONAR Use Cases

2.1 LHCONE

2.1.1 Introduction

CERN (European Organization for Nuclear Research) operates the Large Hadron Collider (LHC) in Geneva, Switzerland. The LHC is a particle accelerator used by physicists to study the smallest known particles – the fundamental building blocks of matter. Physicists are currently using the LHC to recreate the conditions just after the Big Bang, by colliding two beams of subatomic particles head-on at very high energy. Teams of physicists from around the world are currently analysing the particles created in the collisions using sophisticated detectors in four major experiments. These experiments are generating increasingly large amounts of data that are sent to data processing and storage centres around the world. More than 15 petabytes of data (equivalent to over 1.7 million dual-layer DVDs) are generated on a yearly basis [CernLHC].

Given the expected huge amounts of data generated and the requirements to support this experimental challenge, firstly an Optical Private Network (OPN) and then an Open Network Environment (ONE) were designed for the LHC through a collaboration of organisations, including CERN, NRENs and the research community [LHCOPN].

The OPN network is structured on different levels, known as Tiers. Each Tier is responsible for generating and/or processing data and returning the results to the upper Tier, eventually arriving at CERN (Tier 0). The Tier 0 at CERN and eleven other Tier 1 centres – spread around Europe, North America and Asia - are connected by the OPN [LHCOPN].

Subsequent Tiers, mainly composed of universities and/or research centres, are form an active part of the data processing and/or results analysis of the experiments. These lower Tiers are in the process of being connected through the ONE [perfSONAR], a L3VPN-based multipoint-to-multipoint network architecture.

The reliability of the different layers of this complex network structure is of crucial importance for the overall robustness and stability of operations. In particular the requirements for the monitoring process were:

- Scalability.
- Interoperability at the international level.

- Ease of deployment and management.
- Ease of use for network engineers.

2.1.2 A dedicated perfSONAR solution for LHCONE VRF

In the current LHC network design, LHC Tier 1 sites are connected to more than a hundred academic and research institutions across the world (the Tier 2s) through a Multipoint-to-Multipoint network, the LHC Open Network Environment (LHCONE). Network monitoring on such complex network architecture to ensure robust and reliable operation is of crucial importance. The chosen approach for monitoring the OPN and ONE is based on the perfSONAR framework, with a dedicated infrastructure built on perfSONAR MDM for the LHCONE VRF monitoring.

A first solution based on perfSONAR MDM has been demonstrated at the Oslo LHCONE meeting in M41 of the GN3 project (Oslo Technical University, 20-21 September 2012). The demonstration of the weather map was well received, but further development will depend on a convergence of the perfSONAR MDM and perfSONAR PS⁴efforts.

2.1.2.1 *Monitoring the perfSONAR service: the GÉANT Monitoring Infrastructure*

The first monitoring infrastructure built for the LHC project was carried out in GN3 and it consists of a fault monitoring tool, which enables service engineers to proactively deal with certain events, before these become incidents which interrupt the service. Nagios [Nagios] was chosen as the event management tool, since it includes features such as host and service monitoring, and alerting on different sets of events based on their criticality. It enables the support team to react to the current status of the infrastructure, provides reports of the availability of the service monitored for trend analysis and allows the flagging of scheduled maintenance periods. Nagios provides a customizable framework that allows monitoring extensions to be created for any type of service: it is also a good dashboard tool that enables the supporting team to plan any kind of upgrade and/or modification on the monitored infrastructure with great flexibility.

A screenshot of a typical Nagios screen is shown in Figure 2.1.

⁴ perfSONAR PS (<http://psps.perfsonar.net>) is a monitoring toolkit based on the perfSONAR idea, developed by Internet2 and ESnet and mainly used in the US

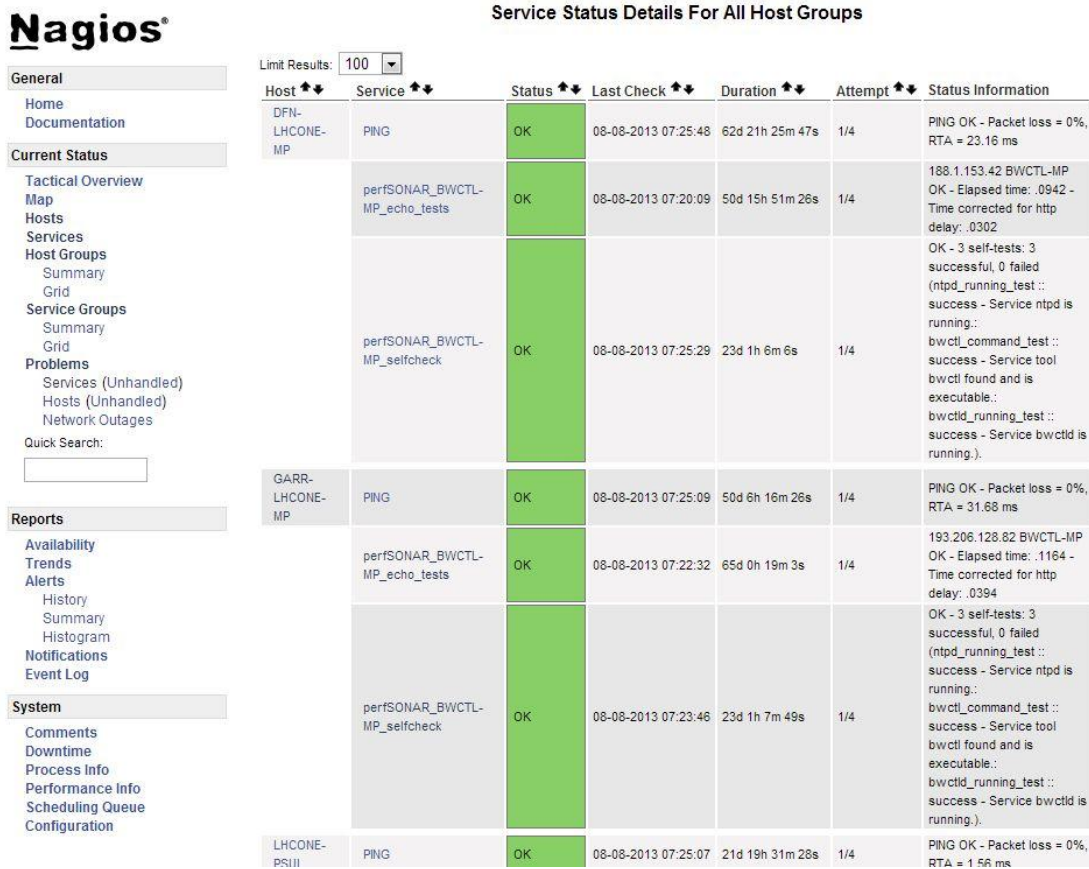


Figure 2.1: Event Management Infrastructure implemented for LHCONE in Nagios

The idea of using Nagios as an event management tool was to show that perfSONAR itself was being effectively monitored and to ensure that we were using a reliable monitoring infrastructure. The results from this initial monitoring exercise is that we are reassured that perfSONAR works as we expected.

2.1.2.2 GÉANT visualization tools for LHCOPN and LHCONE

During the last phase of GN3, the perfSONAR development team assisted the LHC community by working on a series of visualization tools for the LHC project. The tools were aiming at collecting data from both perfSONAR MDM (for Multi-Domain Monitoring) and perfSONAR PS sites and showing them in an intelligible way. This section contains some screenshots taken from the user interfaces currently developed for the T0 and T1 sites.

perfSONAR MDM web user interface

Since 2011, perfSONAR MDM has had a new web interface [perfSONAR_ui] and a special version of this tool has been made available for the LHC community [Subnet].

The interface offers comprehensive access to the following metrics from a single URL:

- Link utilisation, with the possibility of comparing two links.
- One-way delay (OWD).
- One-way delay variation.
- Packet loss.
- Hopcount (i.e. traceroute monitoring) with route comparison.
- A regularly scheduled bandwidth measurement.
- An on-demand bandwidth measurement.

The web interface has been designed in collaboration with a panel of real users. It is, used currently by the GÉANT Network Operation Centre (NOC) engineers and is gradually being adopted by European NOCs. The web interface design has been reviewed by a usability expert and it is customisable in terms of security and access rights. It is easy to manage and available from package repositories for the Debian and Red Hat operating systems. For evaluation purposes, a live virtual machine is available for download from the perfSONAR MDM website [perfSONAR_ui].

Figure 2.2 to Figure 2.5 show examples of how different metrics can be successfully accessed and visualised using the web interface.

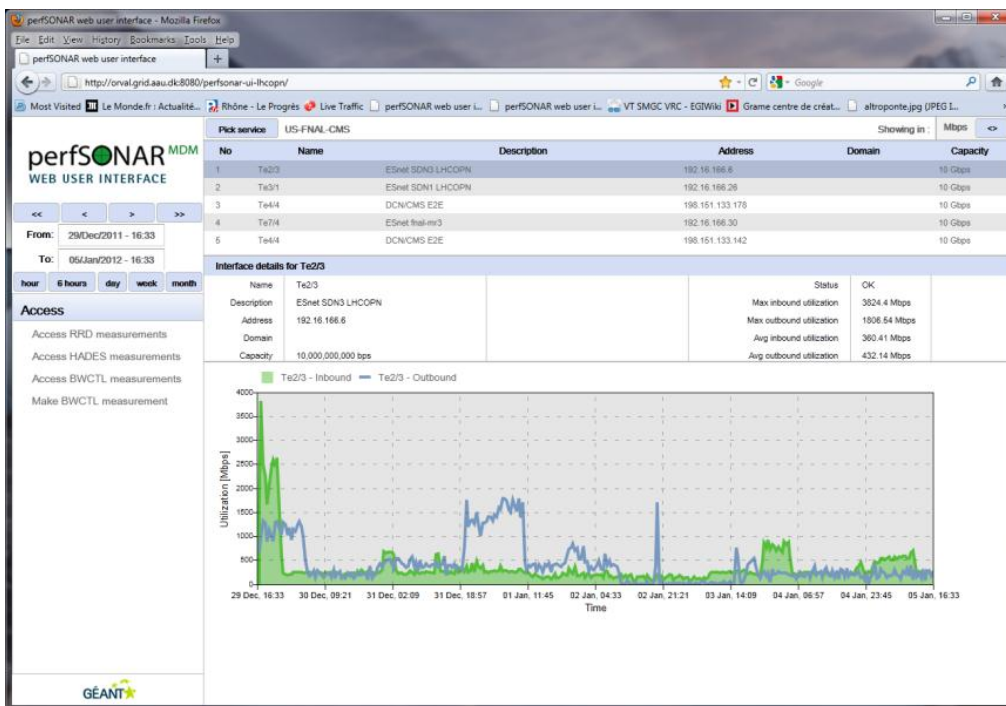


Figure 2.2: Mock-up of link utilisation on the perfSONAR MDM web user interface

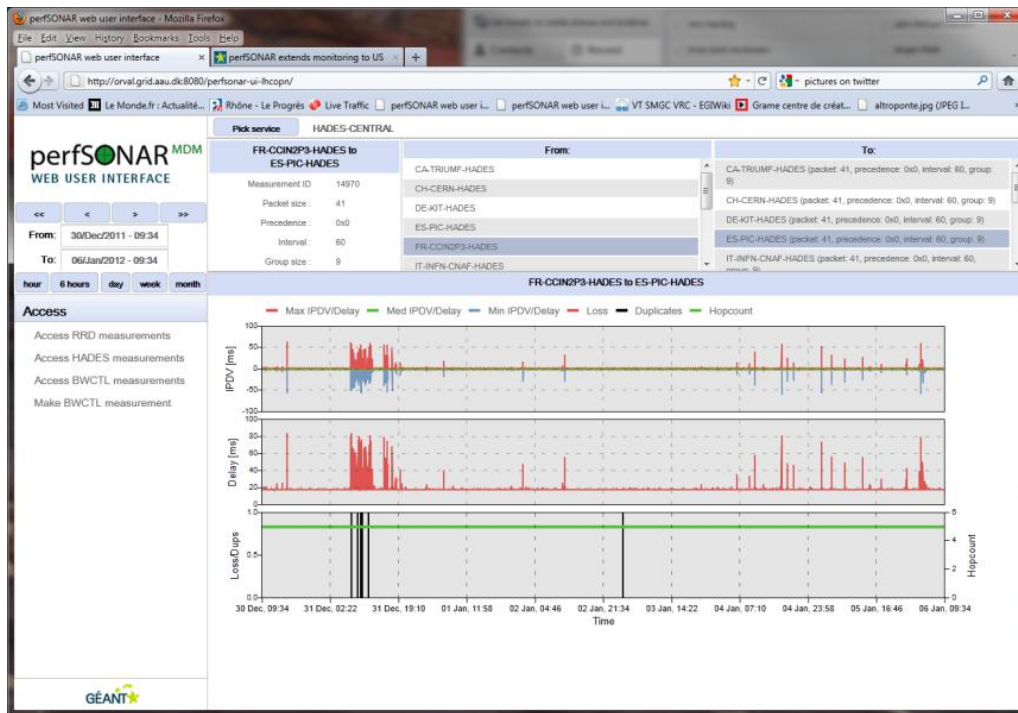


Figure 2.3: Mock-up of One-way Delay, Jitter, Packet Loss and Traceroute on the perfSONAR MDM web user interface

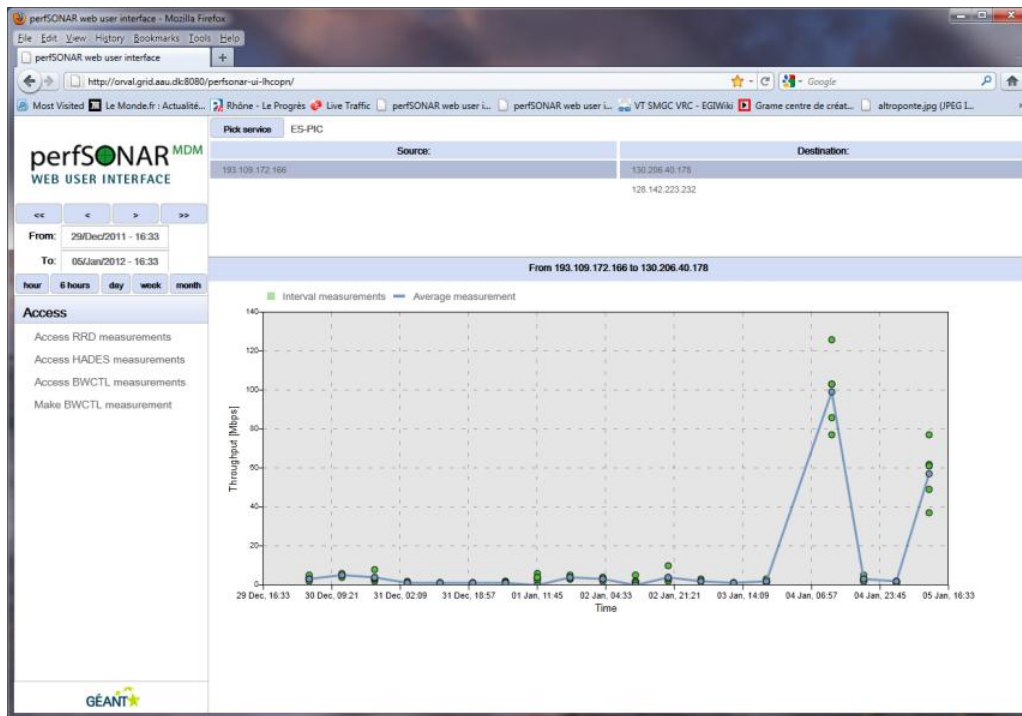


Figure 2.4: Accessing Bandwidth Controller Historic Measurements on the perfSONAR MDM web user interface

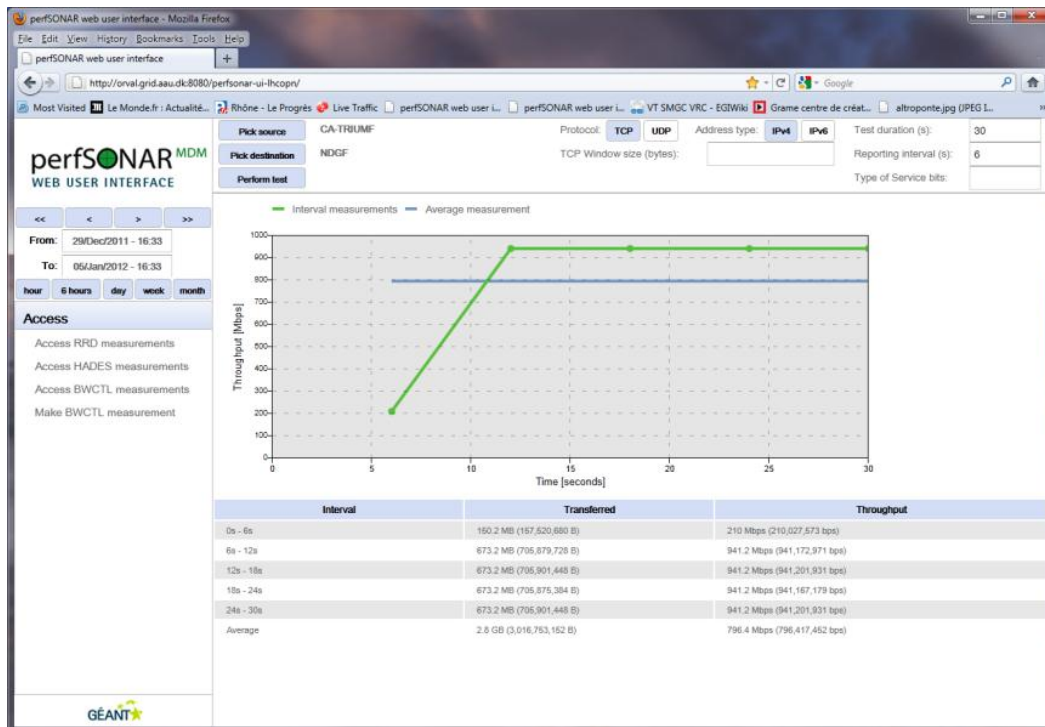


Figure 2.5: Performing an on-demand Bandwidth Controller measurement on the perfSONAR MDM web user interface

perfSONAR MDM weather map for LHCOPN

In addition to the perfSONAR MDM web user interface, a first prototype of a weather map reading live perfSONAR MDM data was prepared for the LHCOPN community within the GN3 project. In the current project, an improved version is currently under design for the LHCONE community. The map displays up to 19 different metrics, offering a colour-coded view according to the metric chosen. The available metrics include:

- OWD.
- Jitter.
- Packet Loss.
- Bandwidth.
- Link utilisation / Input errors / Discarded packets.

Figure 2.6 shows how it is possible to select one of the metrics from the Link Metric Selection drop-down list, and Figure 2.7 shows the final result: a live, colour coded, customised LHCOPN map.

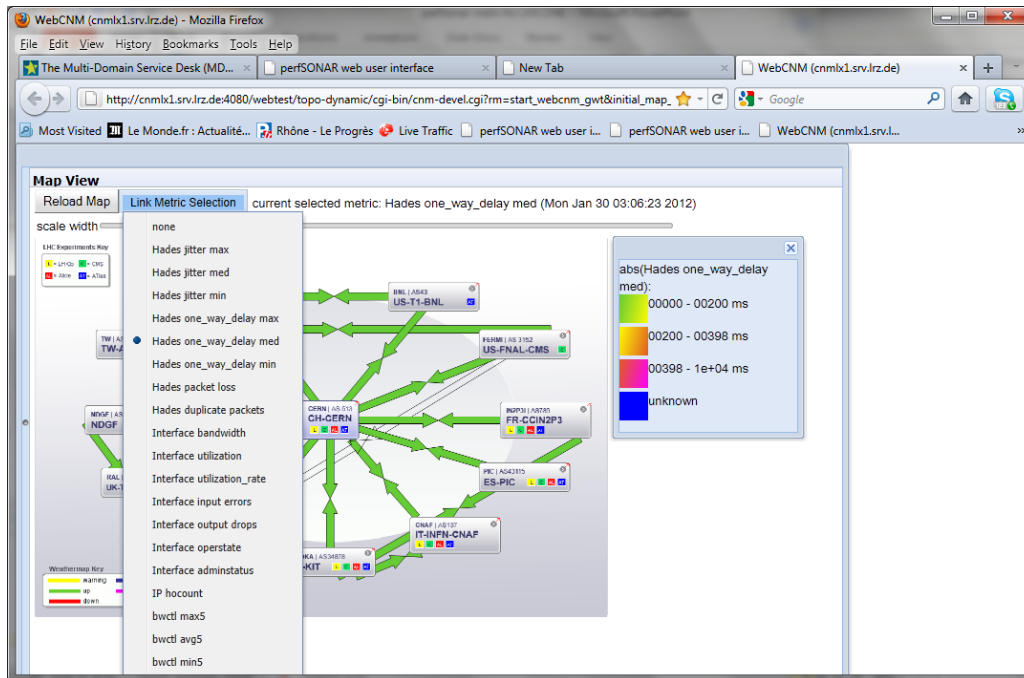


Figure 2.6: Choosing a metric on the weathermap

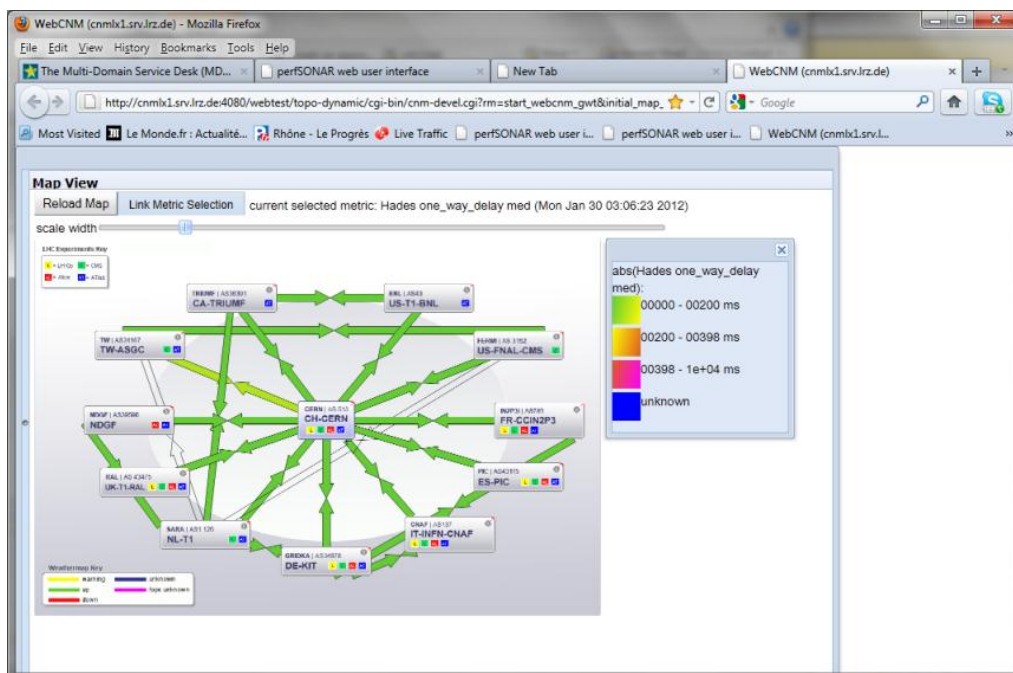


Figure 2.7: The weather map coloured according to the One-Way Delay

2.1.3 The proposed supporting activities

The plan for GN3plus SA4 T1 is to continue supporting the LHC community, with a particular focus on LHCONE VRF monitoring. Several activities have been organised:

- Attending strategic LHCONE events giving updates on perfSONAR MDM.
- Integrating perfSONAR PS services in the perfSONAR MDM web user interface.
- Facilitating the dialogue between the LHC network community and the perfSONAR MDM development team.
- Organising tutorial activities on network monitoring and troubleshooting with perfSONAR, specially customized for the LHC community.

2.2 EGI

2.2.1 Introduction and background

To support science and innovation, a lasting operational model for e-Infrastructure is needed – both for coordinating the infrastructure and for delivering integrated services that cross national borders. The objective of EGI.eu (a foundation established under Dutch law) is to create and maintain a pan-European Grid Infrastructure in collaboration with National Grid Initiatives (NGIs) in order to guarantee the long-term availability of a generic e-infrastructure for all European research communities and their international collaborators. In its role of coordinating grid activities between European NGIs, EGI.eu aims to:

- Operate a secure integrated production grid infrastructure that seamlessly federates resources from providers around Europe.
- Support research communities using the European infrastructure, coordinated by EGI.eu.
- Work with software providers within and outside Europe to provide high-quality innovative software solutions that deliver the capability required by our user communities.
- Ensure the development of EGI.eu through the coordination and participation in collaborative research projects that bring innovation to European Distributed Computing Infrastructures (DCIs).

The EGI.eu is supporting 'grids' of high-performance computing (HPC) and high-throughput computing (HTC) resources. EGI.eu will also be ideally placed to integrate new Distributed Computing Infrastructures (DCIs) such as clouds, supercomputing networks and desktop grids, to benefit the user communities within the European Research Area.

The EGI community is a federation of independent national and community resource providers, whose resources support specific research communities and international collaborators both within Europe and worldwide. EGI.eu, the coordinator of EGI, brings together partner institutions established within the community to provide a set of essential human and technical services that enable secure integrated access to distributed resources on behalf of the community.

The production infrastructure supports Virtual Research Communities (VRCs) that are grouped into specific research domains. VRCs are formally represented within EGI at both a technical and strategic level.

2.2.2 Collaboration between EGI.eu and GÉANT/DANTE

In order to define the framework of collaboration between EGI.eu and GÉANT, a Memorandum of Understanding [MoU] was signed on 16/11/2012.

According to Article 3 of the MoU (the Joint Work Plan), the specific goals of the collaboration are to:

- Exchange information related to long-term strategy, sustainability and business models.
- Investigate common strategies and synergies in the area of cloud computing.
- Increase awareness of the GÉANT service offering within the EGI community, and of the EGI service offer within the GÉANT/NRENs community.
- Establish a support service on network performance, and network monitoring for EGI users.
- Enable EGI and DANTE to obtain user requirements from their respective communities.
- Establish communication channels to exchange requirements or support requests.
- Establish joint dissemination activities to increase awareness and promote the results of the collaboration.

perfSONAR is mentioned explicitly in the MoU, under “WP2 - Support services”, as shown in Figure 2.8:

WP2 – Support Services

Parties Involved: EGI.eu Chief Operations Officer (Tiziana Ferrari); DANTE Head of Product Management (Toby Young)

Description of work: the goal of this work package is to investigate the implementation of a service provided by DANTE through its partners to support EGI users in the following areas: 1) Network performance; 2) Network monitoring and troubleshooting through perfSONAR Multi-Domain Monitoring (perfSONAR MDM); 3) provisioning of EGI technical services on IPv6.

Expected outcome:

- A2.1 (28/02/2013) – Investigation of tools, processes and resources necessary to enable support to EGI users through the EGI helpdesk. This includes the analysis of extensions needed in the support tools and the related processes (Leader Tiziana Ferrari, EGI.eu)
- A2.2 (30/04/2013) – Implementation plan of the network support service including the definition of the related service levels and targets. (Leader: Guenter Grein, KIT on behalf of EGI.eu).

This outcome depends on a positive result of the assessment work carried out in A2.1. Performance of support activities provided through the EGI helpdesk are to be reviewed annually to feed activity A3.2 and A3.4.

Figure 2.8: An extract from EGI.eu and DANTE/GÉANT MoU [MoU], referring to perfSONAR MDM

2.2.3 The proposed supporting activities

During Year 4 of the GN3 project, SA2 T3 started liaising with EGI.eu. In GN3plus, SA4 T1 is to continue supporting the National Grid Initiatives (part of the EGI.eu umbrella) and liaise with the global EGI.eu coordination function. To meet these objectives within the MoU, several activities have been planned for GN3plus:

- Provide assistance and know-how on perfSONAR MDM services and components, installation and maintenance, through the user community.
- Regularly attend EGI Technical and Community forums, giving updates on perfSONAR MDM and promoting its benefits to the grid community.
- Facilitating the dialogue between the EGI.eu network performance community and the perfSONAR MDM development team. This includes organising meetings between the perfSONAR team and the EGI.eu monitoring experts.
- Following the first deployment(s) of perfSONAR and evidence of a growing interest in using the tool in the EGI community, to organise tutorial activities on network monitoring and troubleshooting.

2.3 Future Internet: XIFI

2.3.1 Introduction

The Future Internet (FI) is an emerging, open, communications infrastructure, which aims at supporting innovative services and applications with a better coupling between users and the physical world.

The Future Internet Public-Private-Partnership [FI-PPP] initiative aims to promote FI adoption by supporting the development of a common platform supporting large-scale trials running on a wide range of FI infrastructure.

Within the main FI-PPP frameworks, the XIFI project [XIFI] addresses the infrastructure element of this initiative by paving the way for a unified European market for FI facilities enabling commercial exploitation. The main purpose of XIFI is the creation of a sustainable pan-European open federation of test infrastructures (connecting test beds to ensuring long-term sustainability). This would hopefully enable the design and implementation of large-scale trials, and open the way for widespread and replicable commercial exploitation of FI services and applications.

According to their main website [XIFI], XIFI “establishes a marketplace for test infrastructures and FI services”. The main goal will be sustainability and being able to cope with large trial deployments by leaders of the innovation process.

Initially, XIFI is setting up a core federation of test infrastructures comprised of five nodes, assisted by investments in pan-European infrastructure such as GÉANT. Later, more infrastructures will be added to the federation, in order to respond to a broader set of FI users and experimenters. As such, XIFI should also be

considered not only in the context of the FI-PPP, but also in the context of e-Infrastructures Europe. From this aspect the work carried out within the e-IRG is directly relevant to the XIFI initiative.

In the second year of its operation, XIFI plans to extend its core federation with additional nodes capable of supporting the same level of services.

2.3.2 XIFI activities

The XIFI project started officially on 1 April 2013, with project participants gathered in Rome from 15-17 April 2013 to discuss the approach and agree on forthcoming work items. Representatives from the DANTE/GÉANT network team also attended the event.

It was the first time that all project participants had gathered in one room to exchange their plans, align their ideas and listen to presentations about the FI-PPP programme, as well as the impact the FI-WARE architecture could have on the work of XIFI.

The meeting, hosted by the coordinating organisation, Telecom Italia had more than 60 participants, it established that the XIFI project objectives should be to:

- Integrate infrastructure components with functional components that satisfy the interoperability requirements for the Generic Enablers (GEs) of the FI-WARE core platform.
- Ensure that each infrastructure site is able to offer access to its services through open interfaces, as specified by the FI-PPP collaboration agreement terms and the new governance model agreed at the FI-PPP programme level.
- Support the infrastructure sites that exist in the early trial projects in adapting and upgrading their services and functionality.
- Support more of the existing infrastructures, identified by INFINITY, in adapting and upgrading their services and functionality.
- Leverage the experience and knowledge of federated test beds that has been gained via the FIRE initiative.
- Develop validation procedures to check that each site which joins the XIFI federation is able to provide the required services and is able to support the early trials and phase III (expansion) of the programme.
- Develop the necessary business incentives, in order to lay the ground work for a sustainable ecosystem beyond the horizon of the FI-PPP programme.

2.3.3 perfSONAR MDM for Future Internet

During the project kick-off, perfSONAR MDM has been suggested as the ideal tool for network monitoring over the initial set of data centres/test beds in the following five countries (in addition to the GÉANT backbone domain):

- Italy.

- Ireland.
- France.
- Spain.
- Germany.

XIFI’s initial aim is the creation of a network of testbeds, since the reliability of the network connections is at the very heart of the project.

XIFI works with within a naturally multi-national, distributed and multi-vendor environment. perfSONAR MDM is therefore a suitable candidate for supporting the monitoring needs of the project, since it is able to decouple measuring, presentation and archiving. It can also work with different network equipment and still present the measurements in a consistent way. In addition it is modular, customizable and it is based on open standards, making it easier to interface with similar infrastructure in the world.

Table 2.1 summarises the current status of the monitoring tools and systems used by some XIFI participants at the beginning of GN3plus. As it is evident from the table, a number of these are currently using different and even proprietary monitoring software, so it is important that these sites in particular receive the needed support to deploy perfSONAR MDM.

Site	Monitoring tool currently used
Italy (Trento)	OpenNMS
Ireland (HEAnet)	Nagios
Ireland (WIT)	None
GÉANT	perfSONAR for multidomain performance monitoring, Nagios for low level service monitoring, SNMP stats collection through Cacti.
France (Brittany)	Alcatel-Lucent 1360 COM (managing Alcatel-Lucent devices, proprietary) Devoteam Scrim (SNMP manager; proprietary) Nagios
Spain (Sevilla)	Nagios, ganglia, perfSONAR
Germany (Berlin)	Nagios (but there is availability to support perfSONAR)

Table 2.1: List of the first XIFI sites and their current monitoring tools

2.3.4 The proposed supporting activities

The plan for GN3plus SA4 T1 is to begin liaising with the XIFI community, gathering information and assessing their monitoring requirements and supporting them in their use of a sustainable monitoring infrastructure based on perfSONAR.

To meet these objectives the following activities are planned for GN3plus:

- Liaising with the XIFI networking team to assess their current monitoring requirements.
- Facilitating dialogue between the XIFI network community and the perfSONAR MDM team to ensure that requirement gathering is effective and that support is promptly delivered.
- Supporting the XIFI network engineers in the first sites (from Table 2.1), making sure they have enough information to start deploying a perfSONAR MDM infrastructure in the local site.
- Coordinating with the XIFI sites to facilitate the creation of an overall monitoring infrastructure.

Conclusions

Within GN3plus, the team aims to significantly increase the current reach of perfSONAR as a monitoring and troubleshooting tool. Targeting user communities to achieve this beyond the regular NREN audience is an important objective.

The projects revolving around the LHC are very intensive in their network usage. As such, they have been a strong focus of attention for the perfSONAR community. For the continuation of this work, it is important to engage all actors with interest in the LHCONE area and to work on converging tools, interfaces and communication efforts. perfSONAR-PS has a strong presence there, so it would need to be merged with the MDM approach to deliver our vision of a good service. The services mentioned in section 2.1.2 (monitoring, visualization and weather map), together with supporting components from the MDM toolset, can deliver an excellent user experience. Having the toolset adapted for and used by this large and diverse group should be a strong focus of GN3plus SA4 T1.

EGI similarly is a long-standing initiative that has integrated perfSONAR components in their work over a period of roughly five years. Keeping them engaged and ensuring that we address their requirements over the course of the project should remain SA4 T1's priority.

The emerging project XIFI offers a slightly different challenge to that of LHC and EGI. As a relatively new effort, their requirements and investments in the required technologies and infrastructure for performance monitoring are not as clear. There needs to be a strong focus on communicating the advantages of perfSONAR and in fully supporting their deployments.

References

[CernLHC]	CERN - The Large Hadron Collider. Website: http://public.web.cern.ch/public/en/LHC/
[LHCOPN]	LHCOPN - Large Hadron Collider Optical Private Network. Website: https://twiki.cern.ch/twiki/bin/view/LHCOPN/WebHome LHCONE - Large Hadron Collider Open Network Environment Website: http://lhcone.net/
[perfSONAR]	perfSONAR - Performance focused Service Oriented Network monitoring Architecture Website: http://www.perfsonar.net/
[perfSONAR_ds]	perfSONAR datasheet http://www.geant.net/Media_Centre/Media_Library/Media%20Library/PUB%2012%20053%20perfsonar%20datasheet%2005.12.pdf
[perfSONAR_MDM]	perfSONAR MDM Website: http://perfsonar.geant.net
[Nagios]	Nagios. Website: http://www.nagios.org/
[perfSONAR_ui]	perfSONAR MDM web interface: http://psui.geant.net
[Subnet]	perfSONAR MDM web interface for LHCONE is only accessible within the private subnet: http://62.40.103.5:8080/perfsonar-ui
[FI-PPP]	The Future Internet Public Private Partnership: http://www.fi-ppp.eu/
[XIFI]	XIFI project in The Future Internet Public Private Partnership: https://www.fi-xifi.eu/home.html
[MoU]	Memorandum of understanding between EGI.eu and GÉANT: https://documents.egi.eu/public/RetrieveFile?docid=501&version=10&filename=EGI-MOU-DANTE-Vfinal.pdf

Glossary

BWCTL MP	Bandwidth Controller Measurement Point
CERN	The European Organization for Nuclear Research (originally, Conseil Européen pour la Recherche Nucléaire)
DCI	Distributed Computing Infrastructures
EGI	European Grid Infrastructure
EGI.eu	EGI website (www.egi.eu)
e-IRG	European Grid Infrastructure
FI	Future Internet
FI-PPP	Future Internet Public-Private Partnership
FIRE	Future Internet
FI-WARE	A project to deliver elements (called Generic Enablers) that offer reusable and commonly shared functions to make it easier to develop Future Internet Applications in multiple sectors. http://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Main_Page
GE	(FI-WARE) Generic Enabler. A functional building block of FI-WARE.
HPC	High Performance Computing
HTC	High Throughput Computing
LHC	Large Hadron Collider
LHCONE	LHC Open Network Environment
LHCOPN	LHC Optical Private Network, the network for the T0-T1 data transfer.
MDM	Multi-Domain Monitoring
MoU	Memorandum of Understanding
NOC	Network Operation Centre
NREN	National Research and Education Network
ONE	Open Network Environment
OPN	Optical Private Network
OWD	One-way Delay, a network metric
perfSONAR	Performance focused Service Oriented Network monitoring Architecture, an international collaboration for network monitoring
PERT	Performance Enhancement and Response Team
VRF	Virtual Routing and Forwarding
XIFI	XIFI is a project of the European Public-Private-Partnership on Future Internet (FI) supported by the Seventh Framework Programme